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New records and range extension of the recently reestablished *Lamanonia ulei* (Engl.) L.B. Sm. (Cunoniaceae): notes on taxonomy and conservation

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Abstract

We report new records of the recently reestablished *Lamanonia ulei* (Engl.) L.B.Sm. (Cunoniaceae) from southeastern Brazil. This species is currently known by only eight specimens from Minas Gerais, Rio de Janeiro, and São Paulo states. We present seven new records that include Espírito Santo state in the species distribution, and expand its north and east limits of occurrence. We also present a taxonomic description, photos, occurrence map, conservation status assessment of *L. ulei*, and an identification key for all the species of *Lamanonia* Vell. from Brazil.

Keywords

Atlantic Forest, Geissoieae, Oxalidales, species distribution, Wallacean shortfall.

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Introduction

Lamanonia Vell. (Cunoniaceae) currently comprises six species in southern Paraguay, northern Argentina, and central, eastern, and southern Brazil (Zickel and Leitão 1993; Hopkins 2018), where it is predominantly distributed in the Atlantic Forest domain (Santos-Silva et al. 2020), one of the global hotspots for biodiversity conservation (Myers et al. 2000). Together with *Geissois* Labill., *Pseudoweinmannia* Engl., and *Karrabina* Rozefelds & H.C.Hopkins (genera from western side of the Pacific Ocean), *Lamanonia* is included in the tribe Geissoieae (Bradford and Barnes 2001). It is distinguished from those genera for presenting free lateral stipules, simple axillary inflorescences, and stamens in more than one series (Hopkins 2018).

Since its description by Vellozo (1829), *Lamanonia* was subject to some important taxonomic treatments (e.g., Candolle 1830; Martius 1837; Bentham and Hooker 1862; Engler 1870, 1930; Kuntze 1891; Pampanini 1904; Glaziou 1906; Smith 1958; Biloni 1965; Cuatrecasas and Smith 1971). Subsequently, Zickel and Leitão (1993)

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presented a taxonomic revision of *Lamanonia* providing considerable information on its infrageneric taxonomy, which also included morphological descriptions, illustrations, identification key, and distribution maps. Since then, many information from biological collections has become available and, recently, Hopkins (2018) presented a nomenclatural update of this taxonomic treatment, providing details for all names and their synonyms, and designating lectotypes. One of the updates refers to the reestablishment of *Lamanonia ulei* (Engl.) L.B.Sm., after almost three decades as one of the synonyms of *Lamanonia ternata* Vell., a polymorphic species with wide distribution in South America (Zickel and Leitão 1993).

During the taxonomic review of *Lamanonia* for the "Flora do Brasil 2020" project, we analyzed material of *L. ulei* deposited in different collections of those studied by Hopkins (2018). Considering the importance of knowledge about the distribution of species for the systematics and conservation of biodiversity, we present an update on the distribution of *L. ulei*, including new records for the species, and also assessing its conservation status based on the new data. We present a description, photos, distribution map, and taxonomic, ecological, and geographic distribution comments. We also provide an identification key for all the species of *Lamanonia* from Brazil.

Methods

The studies were conducted based on the collections of the Botanischer Garten und Botanisches Museum Berlin-Dahlem Herbarium, Berlin, Germany (B), Leopoldo Krieger Herbarium, Federal University of Juiz de Fora, Minas Gerais, Brazil (CESJ), Herbarium Collection of the Museu de Biologia Mello Leitão, Espírito Santo, Brazil (MBML), P herbarium, Muséum National d'Histoire Naturelle, Paris, France (P), Rio de Janeiro Botanical Garden Herbarium Collection , Brazil (RB), and Herbarium Collection of the Espírito Santo Federal University, Espírito Santo, Brazil (VIES) (acronyms according to Thiers 2020). The material was examined in person, or through the Jabot (http://jabot.jbrj.gov.br) and Reflora-Herbário Virtual (http://reflora.jbrj.gov.br/reflora/herbarioVirtual) databases. Species identification was based on Zickel and Leitão (1993) and Hopkins (2018). Morphological terminology used in the species description is in accordance with Radford et al. (1974), Zickel and Leitão (1993), Font Quer (2001), and Hopkins (2018). Phenology and distribution data were gathered from specimen labels. Material examined is listed in alphabetical order by specific municipalities and localities. The distribution map was elaborated using QGIS v. 3.8 (QGIS Development Team 2018). Conservation status is in accordance with the IUCN Red List Categories and Criteria (2019). Area of Occupancy (AOO) and Extent of Occurrence (EOO) were inferred through Geospatial Conservation Assessment Tool (GeoCat; Bachman et al. 2011).

Results

***Lamanonia ulei* (Engl.) L.B.Sm., 1958**; Journal of the Washington Academy of Sciences 48: 283.
Figure 1

Type. Brazil • E. Ule Herb. Brasil. 4551 [cited in protologue as 4581]. • Rio de Janeiro, Pedra do Cônico, Nova Friburgo; 17 Jan. 1898; 1300 m a.s.l.;, lectotype, designated by Hopkins (2018), B109009682 (image); isolectotype HBG 506927 (image).

New records. BRAZIL • Espírito Santo, Afonso Cláudio, Serra Pelada, Pedra dos Três Pontões; 18 Jun. 2007; fl.; A.P. Fontana 3375 leg.; MBML 52534. • idem, except: Domingo Martins, Pedra do Colono e Pedra das Flores; 14 Aug. 1999; fr.; J.M.L Gomes 2571 leg.; VIES 35994. • idem, except: Iúna, Serra do Valentim; 01 Dec. 2013; fl.; J.P.F. Zorzanelli 893 leg.; VIES 33374. • Minas Gerais, Araponga, Serra da Araponga, Fazenda Neblina; Dec. 1994; fl.; L.S. Leoni 2729 leg.; RB 667503. • idem, except: Carangola, Morro da Torre; 23 Jun. 1990; fl.; L.S. Leoni 1137 & C. Medeiros leg.; RB 667504 • idem, except: Durandé, Lemos, Comunidade rural Santa Maria, propriedade do Senhor João Carlos Neto; 08 Sept. 2013; fr.; A.C. Tuler 443 leg.; RB 607425. •idem, except: Lima Duarte, Serra Negra, Fazenda Serra Negra; 30 May 2009; fr.; F.S. Souza 682 & J.H.C. Ribeiro leg.; CESJ 53527.

Previous known records. BRAZIL • Minas Gerais, Alto Caparaó, Parque Nacional do Caparaó, trilha Vale Verde; 02 Mar. 2010; fl.; G. Heringer et al. 210 leg.; RB 675999. • idem, except: Caratinga, Alto da Pedra Caratinga, Fazenda Silva; 17 Sept. 1929; fr.; I. Kuhlmann 7 leg.; RB 111079. • Rio de Janeiro: Nova Friburgo; no date; fl.; L.E. Paes 111 leg.; RB 56549. • idem, except: Petrópolis, Serra dos Órgãos; 23 Jul. 2017; fr.; J.M.A. Braga 17-025 leg.; RB 746516. • idem, except: Santa Maria Madalena, Pedra Dubois; 30 Aug. 2016; fl.; C. Baez et al. 985 leg.; RB 659921. • São Paulo, Serra da Bocaína; 18 May 1957; sterile; A.C. Brade leg.; RB 73894.

Identification. Trees 3–6.3 m height; branches cylindrical, glabrous, pubescent in the young region, trichomes ferruginous. Stipules 10–13 × 4 –7 mm, ovate, frequently deciduous. Leaves opposite, composite 3-foliolate; petiole 14–41 mm long, cylindrical, puberulous; lateral leaflets 47.5–100 × 24.7–37 mm, petiolule 2.6–3.4 mm long, median leaflets 65.2–155 × 32.9–63 mm, petiolule 4–11 mm long, strongly discolor, chartaceous, venation craspedodromous, elliptic to ovate, apex acuminate or acute, margin serrate, base cuneate to attenuate, adaxial surface lustrous, glabrous, midvein and secondary veins non prominent, midvein glabrous, rare glabrescent, abaxial surface opaque, densely tomentose, golden trichomes, midvein and secondary veins prominent, midvein tomentose, domatia present. Inflorescence axillary, racemose, axis 82.6–130 mm long, tomentose. Bisexual flowers, actinomorphic, monochlamydeous, white; pedicel 2–5 mm long, villous; sepals-6, united at the base,

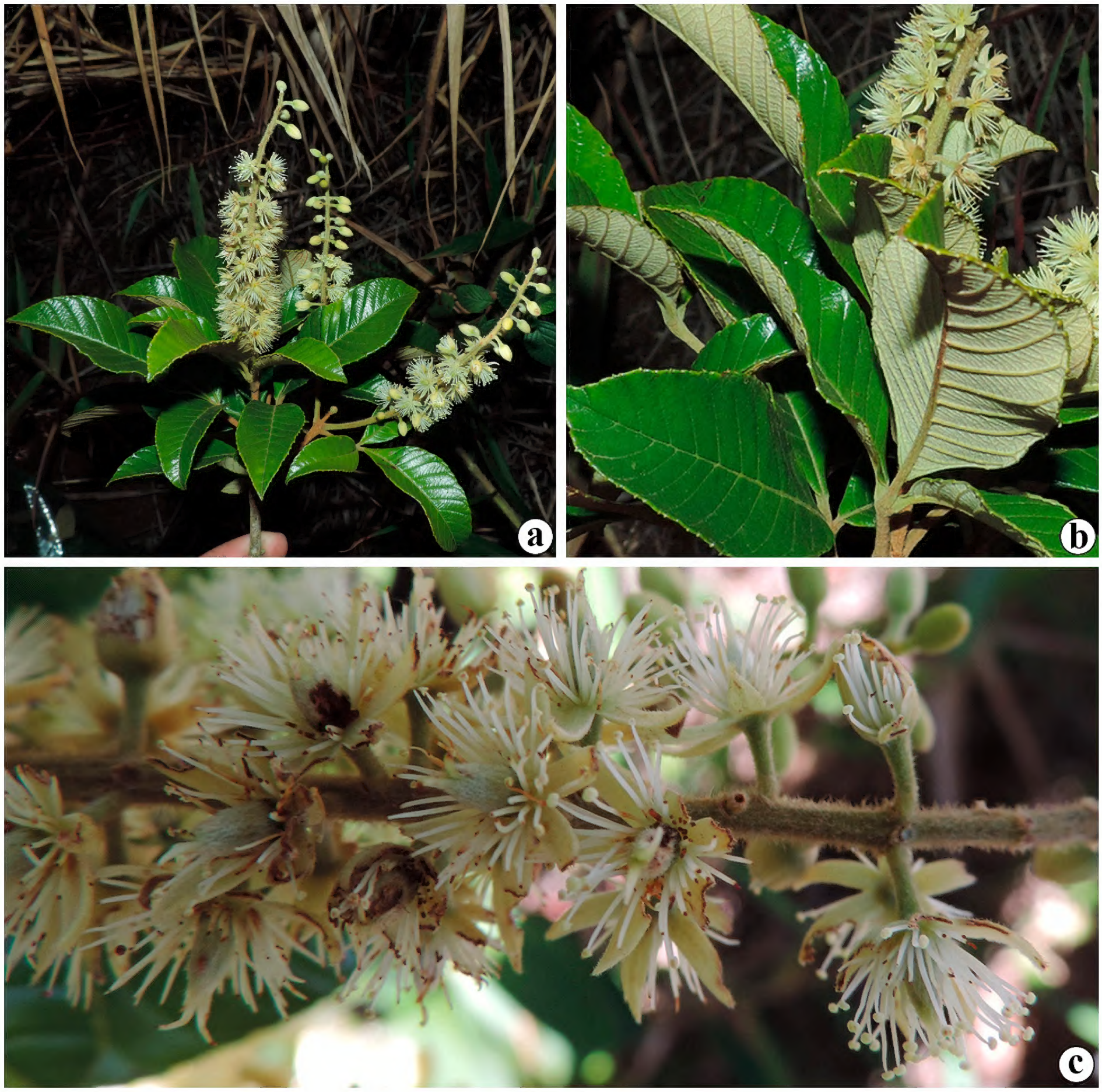

Figure 1. Habit of *Lamanonia ulei* (Engl.) L.B. Sm. (Cunoniaceae). **A.** Habit. **B.** Detail of strongly discolor leaves. **C.** Detail of inflorescence with golden indumentum visible in rachis. Photographs by Patricia da Rosa.

lanceolate, 4–6 mm long, apex acute, externally tomentose, margin ciliated; stamen numerous, 5.1–5.9 mm long, filament free, elongated, glabrous; anthers ovoid, 2-theca; superior-ovary, 2-carpelar, 2-locular, 2–5.5 mm long, densely villous, numerous ovules arranged in two longitudinal series; style 1–2 mm long, glabrous, capitate stigma. Septicidal capsule with partial loculicidal dehiscence, 11.2 × 4.3–6 mm, pubescent, brownish. Seeds numerous, winged, brownish, glabrous.

Identification key to the species of *Lamanonia* in Brazil

Based on Santos-Silva et al. (2020).

1. Inflorescence axis up to 6.5 cm long, ca 20 flowers, filaments hairy ..... *L. chabertii*
1′. Inflorescence axis longer than 6.5 cm long, 30–40 flower, filaments frequently glabrous 2
2. Stipules semi-cordate, coriaceous, ca 1.5 × 1.0 cm .. .. *L. speciosa*
2′. Stipules falcate, chartaceous, ca 0.4 × 0.3 cm 3
3. Fruit ovate to obovate, up to 1 cm long ... *L. cuneata*
3′. Fruit oblong or oblong-elliptic, longer than 1 cm long 4
4. Leaflets strongly discolor, abaxial surface densely tomentose, golden trichomes, veins prominent .... *L. ulei*
4′. Leaflets concolor to slightly discolor, abaxial surface glabrous to pubescent, veins non-prominent 5
5. Leaflets coriaceous, usually glabrous, flowers with ca 40 stamens ..... *L. brasiliensis*
5′. Leaflets chartaceous, usually hairy, flowers with 25–30 stamens ..... *L. ternata*

Ecological comments. *Lamanonia ulei* occurs in an elevation range of 1000–1800 m a.s.l. in open field areas, areas in transition to *campos de altitude,* cloud dwarf forests, riparian forests, and secondary forests. It was found with flowers during March, June, August, September, and December, and with fruits in July and August.

Conservation status. *Lamanonia ulei* presents an EOO of 42,997 km^2 and an AOO of 52 km^2. According to IUCN (2019), this species should be classified as Endangered, due the estimated AOO of less than 500 km^2. However, considering that its populations occur in protected areas (Parque Nacional do Caparaó, Parque Estadual do Desengano, Parque Estadual da Pedra Azul, Parque Estadual da Serra Negra da Mantiqueira), *L. ulei* can be considered as Vulnerable, B2ab(ii, iii). It is noteworthy that some occurrences are on private property. Considering the recent changes in the Brazilian Forest Code (Brasil 2012), these populations might be at greater risk.

Discussion

Engler (1930) published the basionym of *Lamanonia ulei*, distinguishing his new species by the dense, grey, felty indumentum on the lower surface of the leaflets. Zickel and Leitão (1993) considered that the morphology of the only specimen examined of *L. ulei* (type specimen) was a local variation of *L. ternata*, with these characteristics related to xeric environments. These authors also supported this interpretation considering that Leite (1983) visited the type location of *L. ulei* (Pedra do Cônego, Nova Friburgo, Rio de Janeiro state), located one individual that was identified as *L. ternata*, and indicated that *L. ulei* should be considered synonym of *L. ternata.* Consequently, for almost 30 years, *L. ulei* was considered a synonym of the widespread *L. ternata.* In a generic synopsis, Hopkins et al. (2013) indicated the *L. ulei* should be recognized as a species and, later, Hopkins (2018) reestablished *L. ulei*, after examining the type specimens and additional specimens deposited in seven collections available at that moment. During our work on the "Flora do Brasil 2020" project, we analyzed seven additional specimens and were able to confirm the identity of *L. ulei* (i.e., the stability of its diagnostic characters as strongly discolored leaves with golden indumentum, and prominent veins on abaxial surface) along its geographical distribution (Fig. 2).

Lamanonia ulei is currently considered endemic in Southeastern Brazil, restricted to the Atlantic Forest

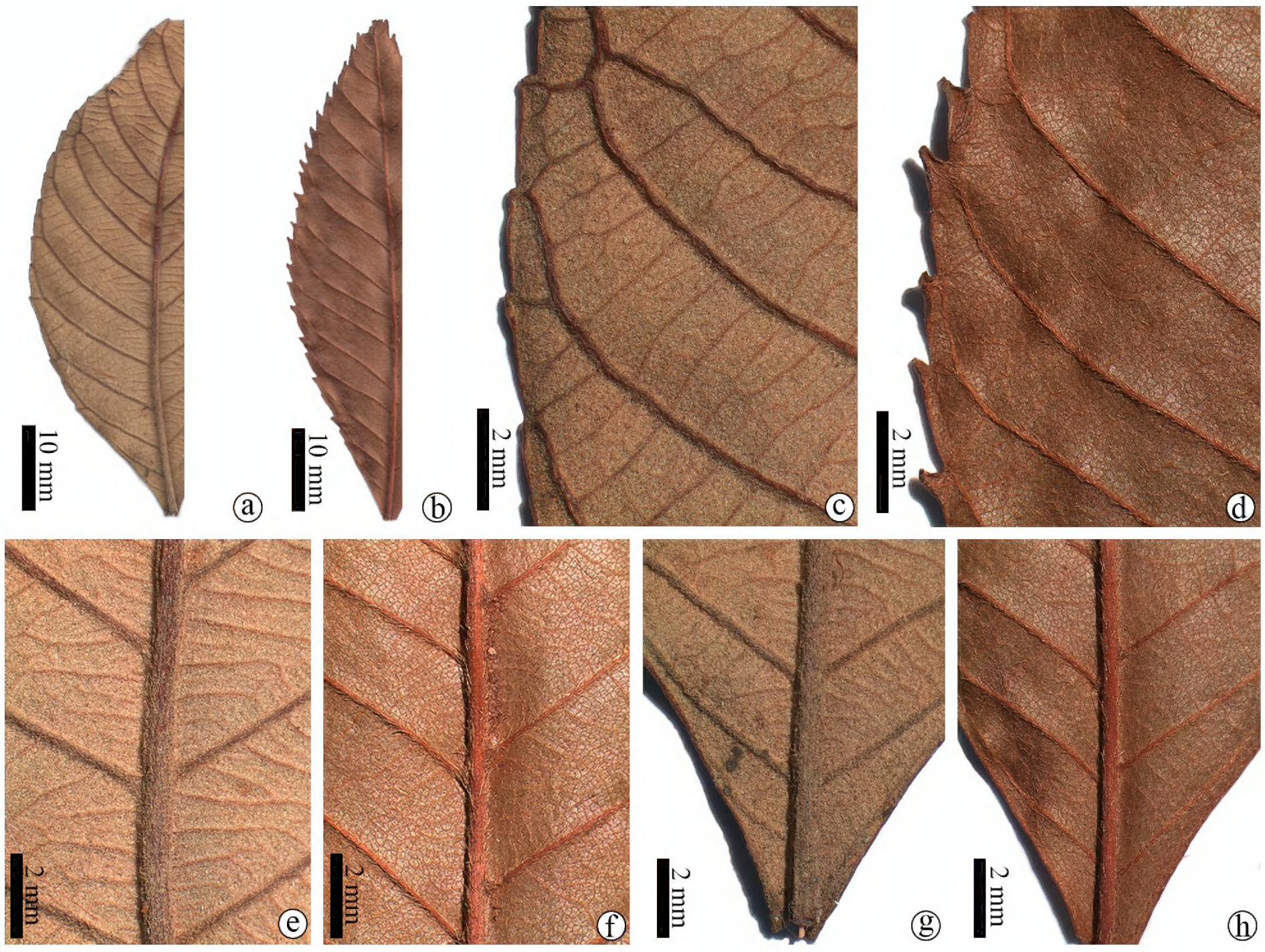

Figure 2. Comparison of *Lamanonia ulei* (Engl.) L.B. Sm. and *L. ternata* Vell. (Cunoniaceae) leaves. **A.** *L. ulei*, general abaxial view. **B.** *L. ternata*, general abaxial view. **C.** *L. ulei*, margin, tertiary veins are visible. **D.** *L. ternata*, margin, tertiary veins are not visible. **E.** *L. ulei*, middle portion. **F.** *L. ternata*, middle portion. **G.** *L. ulei*, base, primary and secondary veins tomentose. **H.** *L. ternata*, base, primary and secondary veins sparse pubescent.

domain. It is distributed in Rio de Janeiro, São Paulo, and Minas Gerais states (Hopkins 2018). Based on three records deposited in Brazilian herbaria, we recorded for the first time its occurrence in Espírito Santo state. Recent studies (Luber et al. 2016; Zorzanelli et al. 2017; Araújo et al. 2018) have highlighted the existence of gaps in floristic knowledge in the state, especially in undersampled regions such as the south. Collection efforts in protected and unprotected areas in this region revealed new records of plant species in sites still poorly studied, as in vegetation located in almost inaccessible mountains (Araújo et al. 2018). Thus, the three new occurrences of *L. ulei* to Espírito Santo state, located in humid vegetation above 1000 m elevation, illustrate the lack knowledge of the richness of the flora in this state, a challenge faced by the "Flora do Estado do Espírito Santo" project, whose objective is to monograph all botanical families through a network of researchers (Dutra et al. 2015). The new records in Espírito Santo state increase range distribution of *L. ulei* to the north and east (Fig. 3).

Hopkins (2018) gave a provisional Red List status of Near Threatened for *L. ulei* and considered the EOO (27,503 km^2), AOO (24 km^2), and the assumed lack of more information about distribution and occurrence in protected areas. However, with the new records presented here, we are able to refine the status of this species as Vulnerable. Both EOO and AOO are increased (42,997 km^2 and 52 km^2, respectively) and the presence of *L. ulei* is confirmed in four distinct protected areas of Espírito Santo, Minas Gerais, and Rio de Janeiro states.

The first record of *L. ulei* in Espírito Santo and additional ones in Minas Gerais emphasize that the knowledge about the distribution of taxa in the Atlantic Forest, mainly regarding to the mountains of southeastern Brazil, is still underestimated. Due to the vulnerability of the montane vegetation to anthropogenic environmental changes, our study contributes to the management and conservation of *L. ulei* populations and its habitats. Our study also highlights the need to increase the collection effort and taxonomic studies dedicated to contribute to the discovery of a diversity still unknown in the Atlantic Forest.

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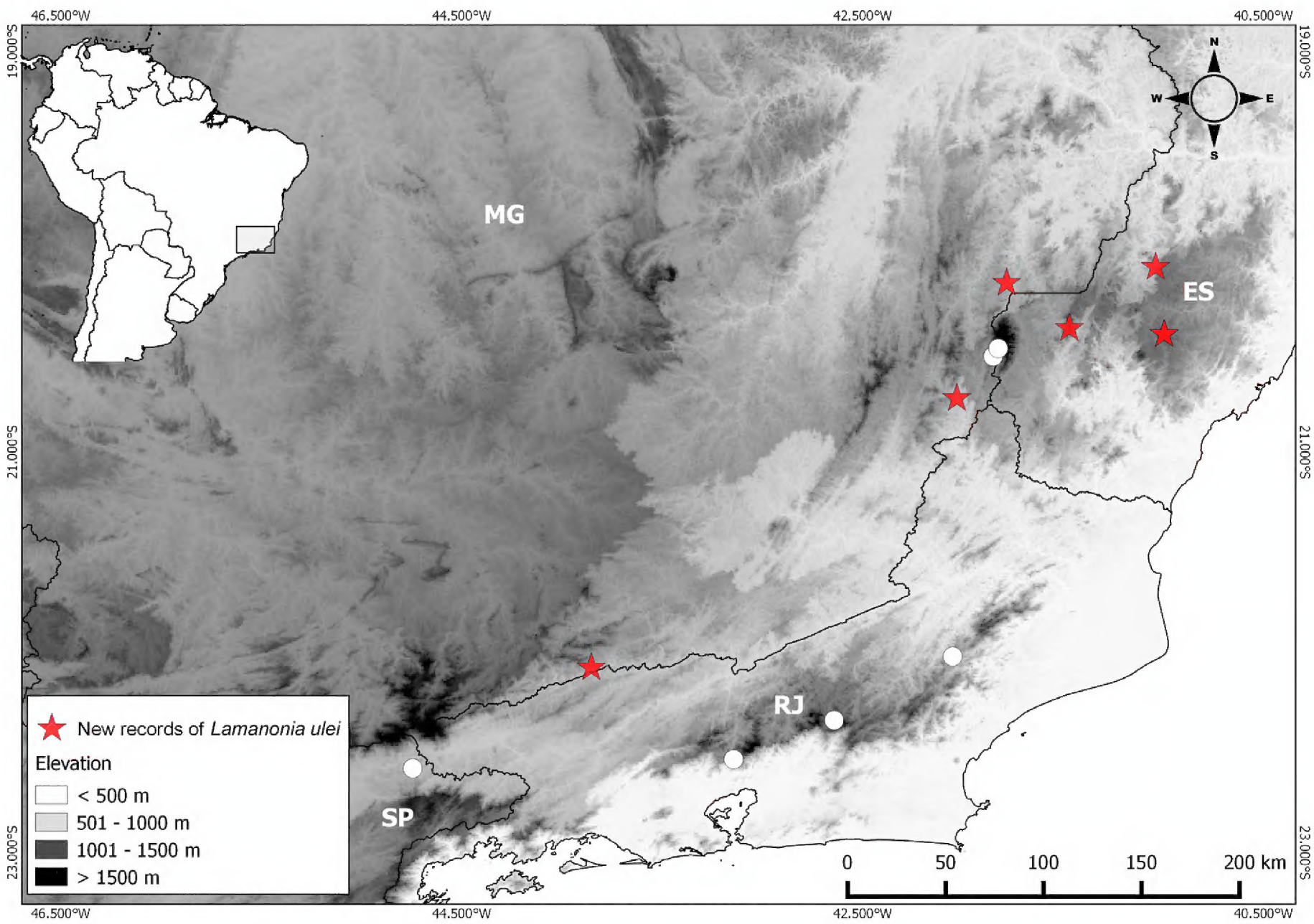

Figure 3. Distribution map of *Lamanonia ulei* (Engl.) L.B. Sm. (Cunoniaceae). Red stars: new records. White circles: previous known records.

Authors' Contributions

FSS, PHC, and AC contributed to the study conception and design. Preparation of materials, data collection, and analysis were performed by FSS, PHC, JPFZ, and AC. The first draft of the manuscript was written by FSS and AC, and all authors commented on subsequent versions of the manuscript. All authors read and approved the final manuscript version.

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